UA Scientists Tweak Genetics, Physiology Of Soybeans To Increase Dryland Yields

FAYETTEVILLE, ARK.

Scientists at the University of Arkansas Division of Agriculture are focusing on two soybean traits that could lead to new soybean varieties with improved drought tolerance.

Larry Purcell, crop physiologist and holder of the Altheimer Chair for Soybean Research, said 15 years of research with collaborators in plant and crop physiology, plant breeding and molecular genetics at the Division of Agriculture and other institutions has shown that prolonged nitrogen fixation and delayed wilting are key traits for improving soybean yields under moderate drought conditions.

Nitrogen fixation, the ability of soybeans and other legumes to use nitrogen from the environment, is one of the first plant activities to cease during drought stress, Purcell said. Nitrogen is key to producing protein.

"Because of high protein and nitrogen concentration in soybean seed, improving nitrogen fixation would appear to be particularly important," Purcell said.

The importance of nitrogen fixation under drought was demonstrated in test plots that compared yield between soybeans with high rates of nitrogen fertilizer and those with no fertilizer. Although there was no difference in fully irrigated plants, Purcell said, yields were about 18 percent greater when nitrogen fertilizer was applied to plants under moderate drought stress.

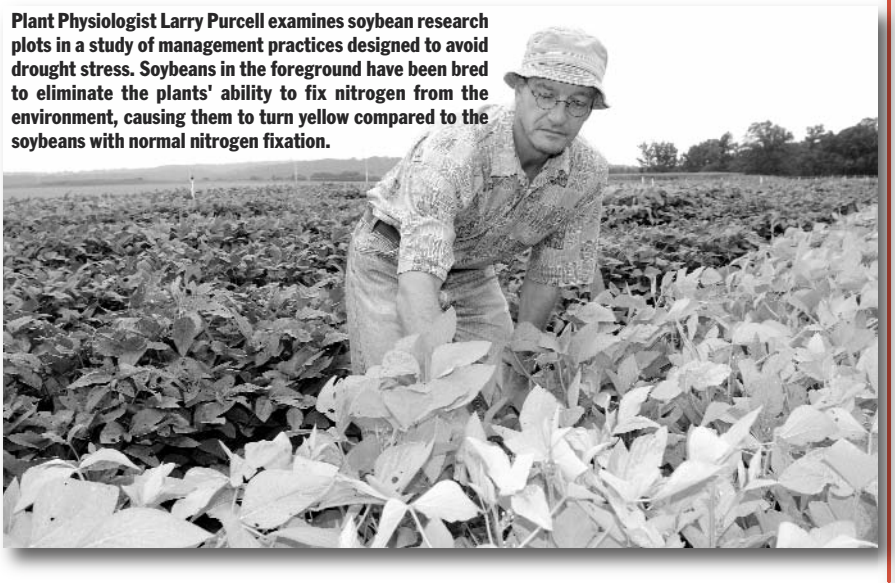
"These results provide evidence that the sensitivity of nitrogen fixation to drought is a plausible target for increasing yield under drought conditions," Purcell said.

Pursuing this avenue, Purcell and soybean breeder Pengyin Chen selected soybean genotypes that have prolonged nitrogen fixation under drought conditions and crossed them with Arkansas breeding lines. The result of their work has been the release of two soybean germplasm lines, R01-416F and R01-581F.

Leaf wilting is an easily recognized symptom of drought stress, Purcell said. In the early 1980s, USDA researcher Tommy Carter first observed exotic soybean genotypes that had delayed wilting under stress and recognized that it might be one means of increasing drought tolerance.

"Through many rounds of breeding, we've developed improved soybean breeding lines that delay wilting during drought," Purcell said.

Under normal conditions, these improved soybean lines produce yields comparable to common commercial varieties used as comparisons during tests, Purcell said. When yields begin to decline because of drought stress, yields from the delayed wilting lines are greater than the check varieties.



Plant Physiologist Larry Purcell examines soybean research plots in a study of management practices designed to avoid drought stress. Soybeans in the foreground have been bred to eliminate the plants' ability to fix nitrogen from the environment, causing them to turn yellow compared to the soybeans with normal nitrogen fixation.

Purcell has developed genetic markers that are used to screen breeding lines for the delayed wilting trait. "We may also be able to use these markers to identify the genes that are responsible for delayed wilting," he said.

Purcell and Chen are working on combining both traits – prolonged nitrogen fixation and delayed wilting – into a single improved breeding line or variety that may be able to better withstand droughts. Δ